



1656
RECEIVED - - - - -

APR 18 2002 PATENT 8 2002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

(Case No. 00-653-A) TECH CENTER 1600/2900

RECEIVED

OCT 22 2001

TECH CENTER 1600/2900

In the Application of:

Chad A. Mirkin, et al.

Serial No.: 09/927,777

Issued: August 10, 2001

For: NANOPARTICLES HAVING
OLIGONUCLEOTIDES ATTACHED
THERE TO AND USES THEREFOR

Examiner: J. Riley

Group Art Unit: 1656

TRANSMITTAL LETTER

Asst. Commissioner for Patents
Washington, D.C. 20231

Sir:

In regard to the above identified application.

1. We are transmitting herewith the attached:

- a) Fourth Supplemental Information Disclosure Statement;
- b) U.S. PTO 1449 Form with copies of 60 references; and
- c) Return Postcard.

2. With respect to additional fees:

A check in the amount of \$0.00 is attached.

3. **GENERAL AUTHORIZATION**: Please charge any additional fees or credit overpayment to Deposit Account No. 13-2490. A duplicate copy of this sheet is enclosed.

4. **CERTIFICATE OF MAILING UNDER 37 CFR § 1.8**: The undersigned hereby certifies that this Transmittal Letter and the paper, as described in paragraph 1 hereinabove, are being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to the Asst. Commissioner for Patents, Washington, D.C. 20231 on this 16 day of October, 2001.

Date:

10/16/2001

Respectfully submitted,

Emily Miao

Registration No. 35,285



RECEIVED

APR 18 2002

TECH CENTER 1600/2900

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
(Our Case No. 00-653-A)

PATENT

TECH CENTER 1600/2900

OCT 22 2001

RECEIVED

In the Application of:

Chad A. Mirkin, et al.

Serial No. 09/927,777

Filed: August 10, 2001

For: NANOPARTICLES HAVING
OLIGONUCLEOTIDES ATTACHED
THERE TO AND USES THEREFOR

Examiner: J. Riley

Art Unit: 1656

Assistant Commissioner for Patents
Washington, D.C. 20231

FOURTH SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Sir:

In order to comply with discretionary regulations 37 CFR §§1.97 and 1.98, attached hereto is Form PTO-1449, copies¹ of the documents listed thereon. These documents contain information which the Examiner may consider to be important in deciding whether to allow the present application to issue as a patent.

1. Ullman et al., U.S. Patent No. 4,193,983 issued 03/18/80
2. Zuk et al., U.S. Patent No. 4,256,834 issued 03/17/81
3. Ullman et al., U.S. Patent No. 4,261,968 issued 04/14/81

¹To the extent that a document is listed and no copy of same is attached, then such document is not at the present time available to the undersigned or is available in the file of a parent application. If a listed document is not in the English language and an English translation is readily available, such translation is also attached; if translation is not attached it is not readily available to the undersigned. If a foreign language patent document is cited, and an English language equivalent is known to the undersigned, then such equivalent patent is also cited on the attached form along with the corresponding foreign language patent and a connecting arrow indicated therebetween; if no such English language equivalent is cited, then none is known to undersigned.

RECEIVED

APR 18 2002



TECH CENTER 1600/2900

Redding, U.S. Patent No. 4,313,734 issued 02/02/82

5. Litman et al., U.S. Patent No. 4,318,707 issued 03/09/82
6. Liu et al., U.S. Patent No. 4,650,770 issued 03/17/87
7. Ullman, U.S. Patent No. 4,713,348 issued 12/15/87
8. Olsen et al., U.S. Patent No. 4,853,335 issued 08/01/89
9. Kurn et al., U.S. Patent No. 4,868,104 issued 09/19/89
10. Henkens et al., U.S. Patent No. 5,255,064 issued 07/06/93
11. Shigekawa et al., U.S. Patent No. 5,294,369 issued 03/15/94
12. Shigekawa et al., U.S. Patent No. 5,384,073 issued 01/24/95
13. Kidwell et al., U.S. Patent No. 5,384,265 issued 01/24/95
14. Kossovsky et al., U.S. Patent No. 5,460,831 issued 10/24/95
15. Beebe et al., U.S. Patent No. 5,472,881 issued 12/05/95
16. Brooks, Jr. et al., U.S. Patent No. 5,514,602 issued 05/07/96
17. Hainfeld et al., U.S. Patent No. 5,521,289 issued 05/28/96
18. Gref et al., U.S. Patent No. 5,543,158 issued 08/06/96
19. Brooks, Jr. et al., U.S. Patent No. 5,571,726 issued 11/05/96
20. Kausch et al., U.S. Patent No. 5,665,582 issued 09/09/97
21. Letsinger et al., U.S. Patent No. 5,681,943 issued 10/28/97
22. International Patent No. WO 89/06801 published 07/27/89
23. International Patent No. WO 97/40181 published 10/30/97
24. International Patent No. WO 98/04740 published 02/05/98
25. International Patent No. WO 99/23258 published 05/14/99
26. European Patent 0 630 974 A2 published 12/28/94

RECEIVED
APR 18 2002
TECH CENTER 1600/2900

RECEIVED

APR 18 2002



TECH CENTER 1600/2900

European Patent 0 667 398 A2 published 08/16/95

TECH CENTER 1600/2900

APR 18 2002

RECEIVED

28. Alivisatos et al., "Organization of 'nanocrystal molecules' using DNA," *Nature*, Vol. 382, pp. 609-611 (1996)
29. Bain, et al., "Modeling Organic Surfaces with Self-Assembled Monolayers," *Angew. Chem. Int. Ed. Engl.*, Vol. 28, pp. 506-512 (1989)
30. Bradley, "The Chemistry of Transition Metal Colloids," *Clusters and Colloids: From Theory to Applications*, G. Schmid, Editor, BCH, Weinheim, New York, pp. 459-542 (1994)
31. Brust et al., "Novel Gold-Dithiol Nano-Networks with Non-Metallic Electronic Properties," *Adv. Mater.*, Vol. 7, pp. 795-797 (1995)
32. Chen et al., "A Specific Quadrilateral Synthesized from DNA Branched Junctions," *J. Am. Chem. Soc.*, Vol. 111, pp. 6402-6407 (1989)
33. Chen & Seeman, "Synthesis from DNA of a molecule with the connectivity of a cube," *Nature*, Vol. 350, pp. 631-633 (1991)
34. Chen et al., "Crystal Structure of a Four-Stranded Intercalated DNA: $d(C_4)^{††}$," *Biochem.*, Vol. 33, pp. 13540-13546 (1994)
35. Dagani, "Supramolecular Assemblies DNA to organize gold nanoparticles," *Chemical & Engineering News*, p. 6-7, August 19, 1996
36. Dubois & Nuzzo, "Synthesis, Structure, and Properties of Model Organic Surfaces," *Annu. Rev. Phys. Chem.*, Vol. 43, pp. 437-464 (1992)
37. Elghanian et al., "Selective Colorimetric Detection of Polynucleotides Based on the Distance-Dependent Optical Properties of Gold Nanoparticles," *Science*, Vol. 277, pp. 1078-1081 (1997)
38. Grabar et al., "Preparation and Characterization of Au Colloid Monolayers," *Anal. Chem.* Vol. 67, pp. 735-743 (1995)
39. Hacia et al., "Detection of heterozygous mutations in BRCA1 using high density oligonucleotide arrays and two-colour fluorescence analysis," *Nature Genet.*, Vol. 14, pp. 441-447 (1996)
40. Jacoby, "Nanoparticles change color on binding to nucleotide target," *Chemical & Engineering News*, p. 10, August 25, 1997

RECEIVED

APR 18 2002



TECH CENTER 1600/2900

41. Letsinger et al., "Use of Hydrophobic Substituents in Controlling Self-Assembly of Oligonucleotides," *J. Am. Chem. Soc.*, Vol. 115, pp. 7533-7536 (1993)

42. Letsinger et al., "Control of Excimer Emission and Photochemistry of Stilbene Units by Oligonucleotide Hybridization," *J. Am. Chem. Soc.*, Vol. 116, pp. 811-812 (1994)
43. Marsh et al., "A new DNA nanostructure, the G-wire, imaged by scanning probe microscopy," *Nucleic Acids Res.*, Vol. 23, pp. 696-700 (1995)
44. Mirkin, "H-DNA and Related Structures," *Annu. Review Biophys. Biomol. Struct.*, Vol. 23, pp. 541-576 (1994)
45. Mirkin et al., "A DNA-based method for rationally assembling nanoparticles into macroscopic materials," *Nature*, Vol. 382, pp. 607-609 (1996)
46. Mirkin et al., "DNA-Induced Assembly of Gold Nanoparticles: A Method for Rationally Organizing Colloidal Particles into Ordered Macroscopic Materials," *Abstract 249*, Abstracts of Papers Part 1, 212 ACS National Meeting 0-8412-3402-7, American Chemical Society, Orlando, FL, August 25-29, 1996
47. Mucic et al., "Synthesis and characterizations of DNA with ferrocenyl groups attached to their 5'-termini: electrochemical characterization of a redox-active nucleotide monolayer," *Chem. Commun.*, pp. 555-557 (1996)
48. Mulvaney, "Surface Plasmon Spectroscopy of Nanosized Metal Particles," *Langmuir*, Vol. 12, pp. 788-800 (1996)
49. Rabke-Clemmer et al., "Analysis of Functionalized DNA Adsorption on Au(111) Using Electron Spectroscopy," *Langmuir*, Vol. 10, pp. 1796-1800 (1994)
50. Roubi, "MOLECULAR MACHINES - Nanodevice with rotating arms assembled from synthetic DNA," *Chemical & Engineering News*, p. 13, (Jan. 1999)
51. Seeman et al., "Synthetic DNA knots and catenanes," *New J. Chem.*, Vol. 17, pp. 739-755 (1993)
52. Shaw & Wang, "Knotting of a DNA Chain During Ring Closure," *Science*, Vol. 260, pp. 533-536 (1993)

APR 18 2002

RECEIVED

TECH CENTER 1600/2900



RECEIVED

APR 18 2002

TECH CENTER 1600/2900

53. Shekhtman et al., "Stereostructure of replicative DNA catenanes from eukaryotic cells," *New J. Chem.* Vol. 17, pp. 757-763 (1993)

54. Smith and Feigon, "Quadruplex structure of Oxytricha telomeric DNA oligonucleotides," *Nature*, Vol. 356, pp. 164-168 (1992)

55. Thein et al., "The use of synthetic oligonucleotides as specific hybridization probes in the diagnosis of genetic disorders," 2nd Ed., K.E. Davies, Ed., Oxford University Press, Oxford, New York, Tokyo, p. 21-33 (1993)

56. Wang et al., "Assembly and Characterization of Five-Arm and Six-Arm DNA Brached Junctions," *Biochem.*, Vol. 30, pp. 5667-5674 (1991)

57. Wang et al., "A DNA Aptamer Which Binds to and Inhibits Thrombin Exhibits a New Structural Motif for DNA," *Biochem.*, Vol. 32, pp. 1899-1904 (1993)

58. Weisbecker et al., "Molecular Self-Assembly of Aliphatic Thiols on Gold Colloids," *Langmuir*, Vol. 12, pp. 3763-3772 (1996)

59. Wells, "Unusual DNA Structures," *J. Biol. Chem.*, Vol. 263, pp. 1095-1098 (1988)

60. Zhang et al., "Informational Liposomes: Complexes Derived from Cholesteryl-conjugated Oligonucleotides and Liposomes," *Tetrahedron Lett.*, Vol. 37, pp. 6243-6246 (1996)

In accordance with MPEP Sections 609 and 707.05(b), it is requested that each document cited (including any cited in applicant's specification which is not repeated on the attached Form PTO-1449) be given thorough consideration and that it be cited of record in the prosecution history of the present application by initialing on Form PTO-1449. Such initialing is requested even if the Examiner does not consider a cited document to be sufficiently pertinent to use in a rejection, or otherwise does not consider it to be prior art for any reason, or even if the Examiner does not believe that the guidelines for citation have been fully complied with. This is requested so that each document becomes listed on the face of the patent issuing on the present application.

RECEIVED
APR 18 2002
TECH CENTER 1600/2900

RECEIVED

APR 18 2002

TECH CENTER 1600/2900



RECEIVED

APR 18 2002

TECH CENTER 1600/2900

The present Disclosure Statement is being submitted in compliance with 37 CFR 1.56 insofar as an Examiner might consider any of the cited documents important in deciding whether to allow the application to issue as a patent, but the citation of each document is not to be construed as an admission that such document is necessarily relevant or prior art. No representation is intended that the cited documents represent the results of a complete search, and it is anticipated that the Examiner, in the normal course of examination, will make an independent search and will determine the best prior art consistent with 37 CFR 1.104(a) and 1.106(b) and, in the course of each search, will review for relevance every document cited on the attached form even if not initialed.

Early and favorable consideration is earnestly solicited.

Respectfully submitted,

A handwritten signature in black ink, appearing to be "Emily Miao", written over a horizontal line.

Emily Miao
Registration No. 35,285

Dated: October 16, 2001

McDonnell Boehnen Hulbert & Berghoff
300 South Wacker Drive
Chicago, Illinois 60606
Telephone : (312) 913-0001
Facsimile: (312) 913-0002

Form PTO-1449

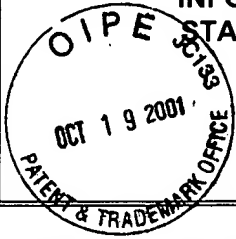
U.S. Department of Commerce
Patent and Trademark Office

Atty. Docket No.

Serial No.

00-653-A

09/927,777

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**

Applicant: Chad A. Mirkin, et al.

Filing Date: 08/10/01

Group: 1656

OCT 22 2001
TECH CENTER 1600/2900**U.S. PATENT DOCUMENTS**

Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date
	1.	4,193,983	3/18/80	Ullman et al.			
	2.	4,256,834	3/17/81	Zuk et al.			
	3.	4,261,968	4/14/81	Ullman et al.			
	4.	4,313,734	2/2/82	Leuvering			
	5.	4,318,707	3/9/82	Litman et al.			
	6.	4,650,770	3/17/87	Liu et al.			
	7.	4,713,348	12/15/87	Ullman			
	8.	4,853,335	8/1/89	Olsen et al.			
	9.	4,868,104	9/19/89	Kurn et al.			
	10.	5,225,064	7/6/93	Henkens et al.			
	11.	5,294,369	3/15/94	Shigekawa et al.			
	12.	5,384,073	1/24/95	Shigekawa et al.			
	13.	5,384,265	1/24/95	Kidwell et al.			
	14.	5,460,831	10/24/95	Kossofsky et al.			
	15.	5,472,881	12/5/95	Beebe et al.			
	16.	5,514,602	05/07/96	Brooks, Jr. et al.			
	17.	5,521,289	5/28/96	Hainfeld et al.			
	18.	5,543,158	8/6/96	Gref et al.			
	19.	5,571,726	11/05/96	Brooks, Jr. et al.			
	20.	5,665,582	9/9/97	Kausch et al.			
	21.	5,681,943	10/28/97	Letsinger et al.			

RECEIVED
APR 18 2002
TECH CENTER 1600/2900

OTHER DOCUMENTS - Including Author, Title, Date, Pertinent Pages, Etc.

--	--

Examiner	Date Considered
----------	-----------------

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with any communication.

Form PTO-1449	U.S. Department of Commerce Patent and Trademark Office	Atty. Docket No. 00-653-A	Serial No. 09/927,777
INFORMATION DISCLOSURE STATEMENT BY APPLICANT		Applicant: Chad A. Mirkin, et al.	
		Filing Date: 08/10/01	Group: 1656

U.S. PATENT DOCUMENTS

Examiner Initial	Document Number	Date	Name	Class	Subclass	Filing Date

FOREIGN PATENT DOCUMENTS

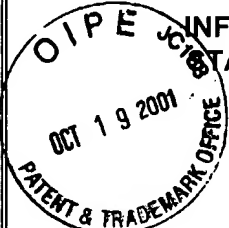
	Document Number	Date	Country	Class	Subclass	Translation Yes No
22.	WO 89/06801	7/27/89	PCT			
23.	WO 97/40181	10/30/97	PCT			
24.	WO 98/04740	2/5/98	PCT			
25.	WO 99/23258	10/30/98	PCT			
26.	0 630 974 A2	12/28/94	EPO			
27.	0 667 398 A2	8/16/95	EPO			

OTHER DOCUMENTS - Including Author, Title, Date, Pertinent Pages, Etc.

28.	Alivisatos et al., "Organization of 'nanocrystal molecules' using DNA," <i>Nature</i> , Vol. 382, pp. 609-611 (1996)
29.	Bain, et al., "Modeling Organic Surfaces with Self-Assembled Monolayers," <i>Angew. Chem. Int. Ed. Engl.</i> , Vol. 28, pp. 506-512 (1989)
30.	Bradley, "The Chemistry of Transition Metal Colloids," <i>Clusters and Colloids: From Theory to Applications</i> , G. Schmid, Editor, BCH, Weinheim, New York, pp. 459-542 (1994)
31.	Brust et al., "Novel Gold-Dithiol Nano-Networks with Non-Metallic Electronic Properties," <i>Adv. Mater.</i> , Vol. 7, pp. 795-797 (1995)
32.	Chen et al., "A Specific Quadrilateral Synthesized from DNA Branched Junctions," <i>J. Am. Chem. Soc.</i> , Vol. 111, pp. 6402-6407 (1989)
33.	Chen & Seeman, "Synthesis from DNA of a molecule with the connectivity of a cube," <i>Nature</i> , Vol. 350, pp. 631-633 (1991)
34.	Chen et al., "Crystal Structure of a Four-Stranded Intercalated DNA: d(C ₄) <i>Biochem.</i> , Vol. 33, pp. 13540-13546 (1994)
35.	Dagani, "Supramolecular Assemblies DNA to organize gold nanoparticles," <i>Chemical & Engineering News</i> , p. 6-7, August 19, 1996

Examiner	Date Considered
----------	-----------------

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with any communication.

Form PTO-1449	U.S. Department of Commerce Patent and Trademark Office	Atty. Docket No. 00-653-A	Serial No. 09/927,777
		Applicant: Chad A. Mirkin, et al.	
		Filing Date: 08/10/01	Group: 1656

U.S. PATENT DOCUMENTS

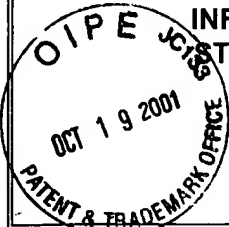
Examiner Initial	Document Number	Date	Name	Class	Subclass	Filing Date

OTHER DOCUMENTS - Including Author, Title, Date, Pertinent Pages, Etc.

36.	Dubois & Nuzzo, "Synthesis, Structure, and Properties of Model Organic Surfaces," <i>Annu. Rev. Phys. Chem.</i> , Vol. 43, pp. 437-464 (1992)
37.	Elghanian et al., "Selective Colorimetric Detection of Polynucleotides Based on the Distance-Dependent Optical Properties of Gold Nanoparticles," <i>Science</i> , Vol. 277, pp. 1078-1081 (1997)
38.	Grabar et al., "Preparation and Characterization of Au Colloid Monolayers," <i>Anal. Chem.</i> Vol. 67, pp. 735-743 (1995)
39.	Hacia et al., "Detection of heterozygous mutations in BRCA1 using high density oligonucleotide arrays and two-colour fluorescence analysis," <i>Nature Genet.</i> , Vol. 14, pp. 441-447 (1996)
40.	Jacoby, "Nanoparticles change color on binding to nucleotide target," <i>Chemical & Engineering News</i> , p. 10, August 25, 1997
41.	Letsinger et al., "Use of Hydrophobic Substituents in Controlling Self-Assembly of Oligonucleotides," <i>J. Am. Chem. Soc.</i> , Vol. 115, pp. 7535-7536 (1993)
42.	Letsinger et al., "Control of Excimer Emission and Photochemistry of Stilbene Units by Oligonucleotide Hybridization," <i>J. Am. Chem. Soc.</i> , Vol. 116, pp. 811-812 (1994)
43.	Marsh et al., "A new DNA nanostructure, the G-wire, imaged by scanning probe microscopy," <i>Nucleic Acids Res.</i> , Vol. 23, pp. 696-700 (1995)
44.	Mirkin, "H-DNA and Related Structures," <i>Annu. Review Biophys. Biomol. Struct.</i> , Vol. 23, pp. 541-576 (1994)
45.	Mirkin et al., "A DNA-based method for rationally assembling nanoparticles into macroscopic materials," <i>Nature</i> , Vol. 382, pp. 607-609 (1996)
46.	Mirkin et al., "DNA-Induced Assembly of Gold Nanoparticles: A Method for Rationally Organizing Colloidal Particles into Ordered Macroscopic Materials," Abstract 249, Abstracts of Papers Part 1, 212 ACS National Meeting 0-8412-3402-7, American Chemical Society, Orlando, FL, August 25-29, 1996
47.	Mucic et al., "Synthesis and characterizations of DNA with ferrocenyl groups attached to their 5'-termini: electrochemical characterization of a redox-active nucleotide monolayer," <i>Chem. Commun.</i> , pp. 555-557 (1996)
48.	Mulvaney, "Surface Plasmon Spectroscopy of Nanosized Metal Particles," <i>Langmuir</i> , Vol. 12, pp. 788-800 (1996)
49.	Rabke-Clemmer et al., "Analysis of Functionalized DNA Adsorption on Au(111) Using Electron Spectroscopy," <i>Langmuir</i> , Vol. 10, pp. 1796-1800 (1994)

Examiner	Date Considered
----------	-----------------

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with any communication.

Form PTO-1449	U.S. Department of Commerce Patent and Trademark Office	Atty. Docket No. 00-653-A	Serial No. 09/927,777
 INFORMATION DISCLOSURE STATEMENT BY APPLICANT		Applicant: Chad A. Mirkin, et al.	
		Filing Date: 08/10/01	Group: 1656

U.S. PATENT DOCUMENTS

Examiner Initial	Document Number	Date	Name	Class	Subclass	Filing Date

FOREIGN PATENT DOCUMENTS

Document Number	Date	Country	Class	Subclass	Translation Yes N

OTHER DOCUMENTS - Including Author, Title, Date, Pertinent Pages, Etc.

50.	Roubi, "MOLECULAR MACHINES – Nanodevice with rotating arms assembled from synthetic DNA," <i>Chemical & Engineering News</i> , p. 13, (Jan. 18, 1999)
51.	Seeman et al., "Synthetic DNA knots and catenanes," <i>New J. Chem.</i> , Vol. 17, pp. 739-755 (1993)
52.	Shaw & Wang, "Knotting of a DNA Chain During Ring Closure," <i>Science</i> , Vol. 260, pp. 533-536 (1993)
53.	Shekhtman et al., "Stereostructure of replicative DNA catenanes from eukaryotic cells," <i>New J. Chem.</i> Vol. 17, pp. 757-763 (1993)
54.	Smith and Feigon, "Quadruplex structure of Oxytricha telomeric DNA oligonucleotides," <i>Nature</i> , Vol. 356, pp. 164-168 (1992)
55.	Thein et al., "The use of synthetic oligonucleotides as specific hybridization probes in the diagnosis of genetic disorders," 2 nd Ed., K.E. Davies, Ed., Oxford University Press, Oxford, New York, Tokyo, p. 21-33 (1993)
56.	Wang et al., "Assembly and Characterization of Five-Arm and Six-Arm DNA Branched Junctions," <i>Biochem.</i> , Vol. 30, pp. 5667-5674 (1991)
57.	Wang et al., "A DNA Aptamer Which Binds to and Inhibits Thrombin Exhibits a New Structural Motif for DNA," <i>Biochem.</i> , Vol. 32, pp. 1899-1904 (1993)
58.	Weisbecker et al., "Molecular Self-Assembly of Aliphatic Thiols on Gold Colloids," <i>Langmuir</i> , Vol. 12, pp. 3763-3772 (1996)
59.	Wells, "Unusual DNA Structures," <i>J. Biol. Chem.</i> , Vol. 263, pp. 1095-1098 (1988)
60.	Zhang et al., "Informational Liposomes: Complexes Derived from Cholesteryl-conjugated Oligonucleotides and Liposomes," <i>Tetrahedron Lett.</i> , Vol. 37, pp. 6243-6246 (1996)

Examiner	Date Considered
----------	-----------------

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with any communication.